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Atty. Dkt. No. SAR 13995

REMARKS

The Applicants have carefully studied the outstanding Office Action ("Action") and the rejection raised therein. The present response is intended to be fully responsive to the rejection raised by the Office, and is believed to place the application in condition for allowance. Further, the Applicants do not acquiesce to any part of the Office's rejection not particularly addressed. Favorable reconsideration and allowance of the application is respectfully requested.

Application Status

The application includes 20 pending claims, namely, claims 1-20. Of these claims 1, 12 and 17 are in independent format. Claims 2-11 ultimately depend from independent claim 1; claims 13-16 ultimately depend from independent claim 12; and claims 18-20 ultimately depend from independent claim 17.

The Applicants thank the Office for noting that claims 1-11 are allowed, and noting that claims 16 and 20 would be allowable if rewritten in independent form and including all of the elements of their independent claims and their intervening claims, if any. In addition, the Office rejected claims 12-13, 15 and 17-18 under 35 USC § 102(b) as being anticipated by U.S. Patent No. 5, 303,417 granted to Peter G. Laws ("Laws"). The Office also rejected claims 14 and 19 under 35 USC § 103(a) as being unpatentable over *Laws* in view of Official Notice taken by the Office. In view of the following, the Applicants respectfully traverse the rejection, and submit that pending claims 1-20 are allowable.

To this end, the Applicants note that the independent claim 12, which is directed to image-reject mixer, includes a novel and nonobvious combination of elements directed to (i) a first mixer having a first filter and a local oscillator (LO) input, (ii) a second mixer having a second filter and a LO input; and (iii) commutating circuitry for commutating the LO inputs of the first mixer and the second mixer between in-phase and quadrature phases." The Applicants further note that independent claims 17, which is directed to a method of rejecting an image signal, also includes a novel and nonobvious combination of elements directed to (i) mixing a radio frequency (RF) signal with a first local oscillation (LO) signal to generate a first intermediate frequency (IF)

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signal, (ii) mixing the first IF signal with a second LO signal to generate a second IF signal, and (iii) commutating the first and second LO signals between in-phase and quadrature phases.

By commutating (i.e., switching repetitively) the first and second LO signals between in-phase and quadrature phases, the present invention has the advantage of deriving IF signals for both upper and lower band signals simultaneously. See *the present specification* at page 11, para. 36.

In addition, all of the claims that depend from independent claims 12 and 17, in turn, necessarily incorporate the elements of the independent claims from which they depend. Thus, in some way or another, each of the claims 12-19 include the combination of elements directed to commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases.

For convenience, the aforementioned combination (or sub-combinations) of elements may sometimes be referred to hereinafter as "the combination of elements directed to (i)-(iii) (or some combination thereof)." The Office is invited to review claims 12-17 for the combination of elements directed to (i)-(iii) above.

Section 102(b) Rejection

As set forth in the Action, the Office stated that *Laws* discloses all of the elements of (i) the independent claim 12 and dependent claims 13 and 15, and (ii) the independent claim 17 and dependent claim 18. With respect to the independent claims 12 and 17 (and via dependency, claims 13-15 and 18-19, respectively), the Office cited to *Laws* at Figure 8 and col. 4, and in particular to, the two "+/-45 phase shift circuits," for the proposition that *Laws* discloses the claimed combination of elements directed to commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases.

The Applicants note that *Laws* at Fig. 8 and col. 4 (which provides a description of Fig. 8) discloses a cascaded or stacked (collectively "stacked") mixer arrangement having two stages of two mixers for a total of four mixers. The first stage of the stacked mixer arrangement includes mixers "MIX 1I" and "MIX 1Q." See *Laws* at Fig. 8 and col. 4. The first stage mixers MIX 1I and MIX 1Q have inputs to receive respective in-phase

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("I") and quadrature ("Q") portions of an RF signal (as opposed to down-converted I and Q portions of an IF signal). *Id.* The second stage of the stacked mixer arrangement includes mixers "MIX 2I" and "MIX 2Q." *Id.* The second stage mixers MIX 1I and MIX 1Q have inputs to receive respective I and Q portions of an IF signal. *Id.* The mixer MIX 1I is directly coupled to and feeds currents to mixer MIX 2I. *Id.* The mixer MIX 1Q is directly coupled and feeds currents to mixer MIX 2Q. *Id.* The +45 phase shift circuit is coupled to the two first stage mixers, namely, the mixers MIX 1I and MIX 1Q, and the -45 phase shift circuit is coupled to two the second stage mixers, namely, the mixers MIX 2I and MIX 2Q. *Id.*

The Applicants also note that the Office pointed to the mixer MIX 2I and mixer MIX 2Q for the proposition that they teach the claimed first and second mixers. *See the Action* at page 3, para. 1.

Response to Section 102(b) Rejection

Contrary to the Office's assertion that *Laws* teaches all of the elements of the claims 12 and 17 as required under 35 USC § 102(b), the Applicants submit that *Laws* fails to teach or suggest all of the claimed combination of elements (i)-(iii). At a minimum, *Laws* does not teach or suggest the claimed combination of elements directed to commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases.

As noted above, *Laws* teaches a stacked or cascaded mixer arrangement in which the mixer MIX 1I is directly coupled and feeds currents to the mixer MIX 2I, and the mixer MIX 1Q is directly coupled and feeds currents to mixer MIX 2Q. In addition, *Laws* explicitly discloses:

"Thus the abovementioned drawbacks can be greatly reduced by using stacked (cascaded) mixers such that the differential output currents from the first mixing stage are fed directly into the second mixer commutating devices. Hence in practice this takes the form of a double balanced mixer. A consequence of directly coupling the mixers in this way means that separate first stage mixers are required for I and Q branches.

From closer inspection of the double balanced mixer arrangement it can be shown that optimum commutation of the RF input will result when the

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LO inputs are in quadrature phase. Indeed in this case the combined commutation is the same as that of a single mixer with an LO input at the RF frequency as in the basic direct conversion system! From this it may be reasoned that the overall mixing efficiency is not reduced and that the only increase in noise would be due to the second mixer commutating devices. However, since the half frequency LO does not cause any pick up problems its amplitude may be increased enabling the effective mixer gain to increase with less noise contribution from all the mixer commutating devices. Note that attention should be paid to minimising the second harmonic of the LO as this will be at the wanted RF frequency" (emphasis added). *Id.* at col. 2, line 63 to col. 3, line 18.

As can be readily discerned from the above quoted section and the rest of *Laws*, *Laws* requires separate first stage mixers for I and Q branches. Being directly coupled to the second stage mixers (and not described or shown as being otherwise connected), *Laws* likewise requires separate second stage mixers for the I and Q branches. And in the section cited by the Office, *Laws* states:

"FIG. 8 shows a possible architecture for a half frequency direct conversion transceiver system. The half frequency receiver mixers may be implemented using bipolar transistors as shown in FIG. 9. Quadrature RF input signals are feed into Q1 R1 and Q2 R2 which generate the tail currents for the two stacked mixers. The I channel is made up from Q5 and Q6 forming the first mixer stage with Q9-Q12 forming the second stage. A differential output stage is shown with R3 and R4 converting the mixer output currents into voltages. A cascade stage consisting of Q3 has been included to help reduce any LO induced signals being feed through to the RF input. The Q channel is constructed in a similar fashion" (emphasis added). *Id.* at col. 4, lines 1-14.

See also FIG. 8, which shows that the output of the mixer MIX 2I and mixer MIX 2Q are I and Q signals, respectively. Clearly, the mixer MIX 2I only receives and outputs I signals, and the mixer MIX 2Q only receives and outputs Q signals.

Moreover, the Applicants note the section of *Laws* cited by the Office with respect to the +/-45 phase shift circuits is entirely silent with respect to any teaching relating to commutation, much less commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases. Instead, the +45 phase shift circuit (or -45 degree phase shift circuit) provides a constant +45 degree phase shift (-45 degree phase shift) to the LO signal input to both of the mixers MIX 1I and MIX 1Q (or both of mixers MIX 2I and MIX 2Q), whereas the Applicants' invention

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commutates (i.e., switches repetitively) between the I and Q phases the LO signals applied to the first and second mixers.

In addition, the Applicants note that *Laws* at FIG. 6 (and accompanying description) show and describe with the same terms the same arrangement of mixers and +/-45 phase shift circuits shown in and described with respect to FIG. 8. With respect to FIG. 6, *Laws* states:

"An alternative approach is shown in FIG. 6. Here the I and Q outputs are determined by the phase shifted RF inputs. Since the LO drives are common to the mixer stages good matching between the two channels will automatically result. The phase difference between the two LO drives is not critical as this should only have a marginal effect on the mixing efficiency and create a constant DC shift on the outputs. This shift is due to the stacked mixers acting as a phase comparator between the two LO inputs. An additional advantage is that a transmit frequency may be generated using a further stacked mixer as shown in FIG. 7, utilising the same two LO inputs" (emphasis added). *Id.* at col. 3, lines 56-68.

As is readily evident from the foregoing quote and the rest of *Laws*, the LO drives provide to the inputs of the mixers MIX 1I and MIX 1Q a first LO signal, which is shifted by +45 degrees by the +45 phase shift circuitry. The mixer MIX 1I uses the first LO signal in combination with the RF signal to generate the I portion of the IF signal ("I_{IF} signal"). Similarly, the mixer MIX 1Q uses the first LO signal in combination with the RF signal to generate the Q portion of the IF signal ("Q_{IF} signal").

The LO drive also provides to the inputs of the mixer MIX 2I and MIX 2Q a second LO signal, which is shifted by -45 degrees by the -45 phase shift circuitry. Similar to the first stage, the mixer MIX 2I uses the second LO signal in combination with the I_{IF} signal to generate an output I signal, and the mixer MIX 2Q used the second LO signal in combination with the Q_{IF} signal to generate the output Q signal. Thus, the Applicants submit *Laws* fails to disclose that the +/-45 phase shift circuits perform any commutation, much less commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases.

In view of the foregoing, the Applicants submit that *Laws* fails to anticipate the independent claims 12 and 17. In addition, each of the dependent claims 13-15 and 18-19 necessarily includes the elements of the independent claims from which it depends.

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Since the Applicants submit that *Laws* fails to anticipate the independent claims 12 and 17 for the reasons set forth above, the Applicants further submit that *Laws* likewise fails to anticipate each of the dependent claims 13-15 and 18-19. Thus, the Applicants submit that the claims 12-15 and 17-19 fully satisfy the requirements of 35 U.S.C. §102, and therefore, are allowable.

Section 103(a) Rejection

As set forth in the Action, the Office rejected claims 14 and 19 under 35 USC § 103(a) as being unpatentable over *Laws* in view of Official Notice taken by the Office. More particularly, the Office admitted that *Laws* "does not explicitly disclose that the clock signals are square waves." To support the section 103(a) rejection, the Office stated that "square waves are well known and widely used in the communication circuitry." In addition, the Office stated "the motivation for using square waves is the ease of having 50 percent duty cycle clock signal." And "the mixers can easily be implemented as integrated circuits, and thus, can be manufactured inexpensively."

Response to Section 103(a) Rejection

In order to establish the required *prima facie* case of obviousness of a claimed invention by applying a combination of references, the proposed combination must teach or suggest all of the elements of the claimed invention. See M.P.E.P. § 2143. The aforementioned rejection is respectfully traversed.

The Proposed Combination Does Not Teach or Suggest All the Elements

The Applicants respectfully submit that the combination of *Laws* and the *Official Notice* fails to teach and/or suggest all of the claimed elements of the independent claims 12 and 17, much less the dependent claims 14 and 19. That is, the art cited by the Office, alone or combined, fails to teach or suggest the combination of claimed elements directed to (i)-(iii) above.

The Applicants incorporate herein by reference the discussion from under the heading 'Response to Section 102(b) Rejection.' The Applicants also note that the Office did not take the *Official Notice* for the proposition of teaching the claimed

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elements directed to commutating the LO signals of the first mixer and the second mixer between in-phase and quadrature phases.

Given that (1) *Laws* does not teach or suggest the combination of claimed elements directed to (i)-(ii) and (2) the Official Notice likewise fails to disclose such subject matter, the Applicants submit that these references either alone or combined, fail to disclose or suggest, all of the claimed elements. Thus, the Applicants submit that the Office failed to raise a *prima facie* case of obviousness with respect to the dependent claims 14 and 19. Therefore, the Applicants contend that claims 14 and 19 are patentable over *Laws* and the *Official Notice*, and as such, fully satisfy the requirements of 35 U.S.C. §103.

CONCLUSION

The Applicant submits that the application is in good and proper form for allowance, and respectfully requests the Office to pass this application to issue. If, in the opinion of the Office, a telephone conference would expedite the prosecution of this application, the Office is invited to call the undersigned attorney directly at 732-978-4890 or the office of the undersigned attorney at 732-978-7100.

Respectfully submitted,

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